TVS Diodes

Transient Voltage Suppressor Diodes

ESD5V5U5ULC

Ultra-low Capacitance ESD / Transient / Surge Protection Array

ESD5V5U5ULC

Data Sheet

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1 Ultra-low Capacitance ESD / Transient / Surge Protection Array

1.1 Features

- ESD / Transient protection of high speed data lines exceeding
  - IEC61000-4-2 (ESD): ±25 kV (air / contact)
  - IEC61000-4-4 (EFT): ±2.5 kV / ±50 A (5/50 ns)
  - IEC61000-4-5 (surge): ±6 A (8/20 µs)
- Maximum working voltage: V_{RWM} = 5.5 V
- Extremely low capacitance C_L = 0.45 pF I/O to GND (typical)
- Very low dynamic resistance: R_{DYN} I/O to GND = 0.2 Ω (typical)
- Very low reverse clamping voltage: V_{CL} = 9 V at I_{PP} = 16 A (typical)
- Protection of V_{BUS} with one line freely selectable
- Pb-free (RoHS compliant) and halogen free package

1.1.1 Application Examples

- USB 2.0, 10/100/1000 Ethernet, Firewire
- Consumer products (STB, MP3, DVD, DSC, ...) Notebooks and desktop computers, peripherals
- DVI, HDMI, S-ATA, DisplayPort, Mobile communication, LCD displays, Camera

2 Product Description

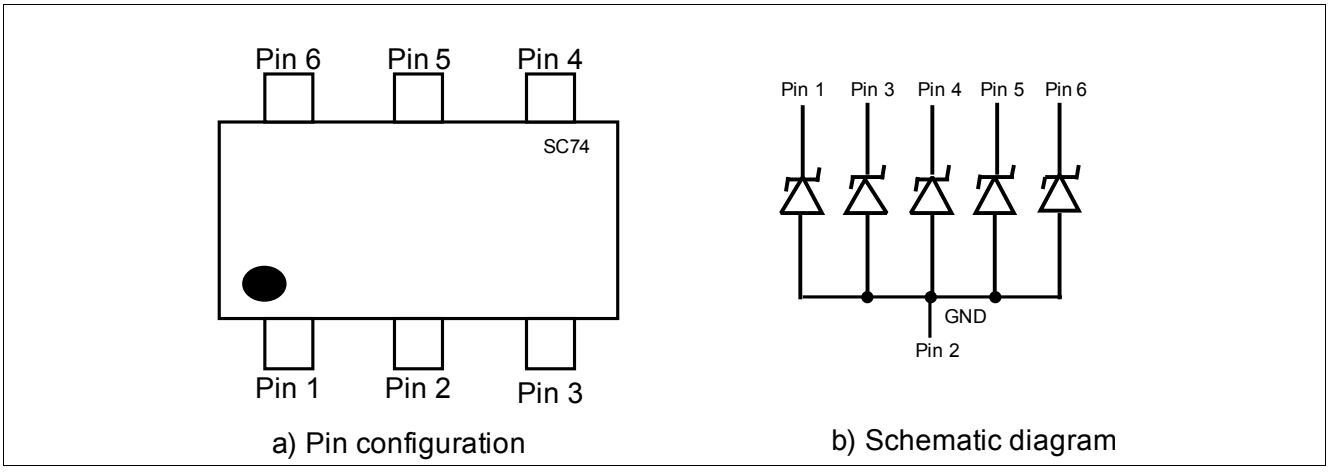

Figure 1 Pin Configuration and Schematic Diagram

Table 1 Ordering Information

Type	Package	Configuration	Marking code
ESD5V5U5ULC	SC74	5 lines, uni-directional	20

3 Characteristics

Table 2 Maximum Rating at T_A = 25 °C, unless otherwise specified

Parameter	Symbol	Values			Unit
		Min.	Typ.	Max.	
ESD contact discharge[1)]	V_{ESD}	–	–	25	kV
Peak pulse current (t_p = 8/20 µs)[2)]	I_{PP}	–	–	6	A
Operating temperature range	T_{OP}	-40	–	125	°C
Storage temperage	T_{stg}	-65	–	150	°C

1) V_{ESD} according to IEC61000-4-2

2) I_{PP} according to IEC61000-4-5

3.1 Electrical Characteristics at T_A = 25 °C, unless otherwise specified

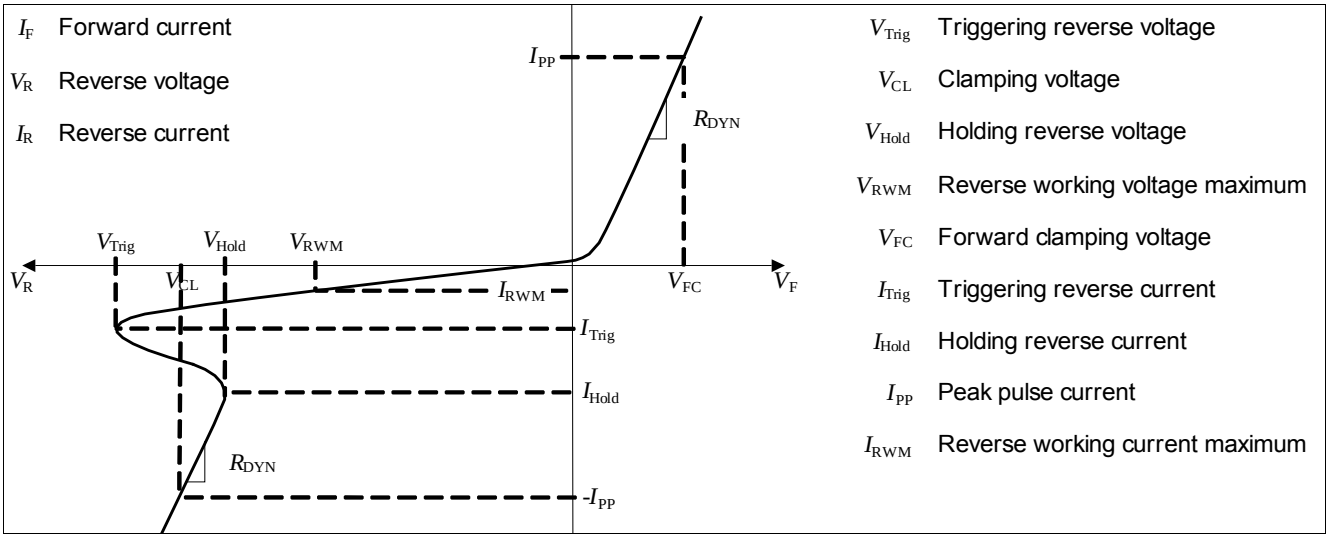

Figure 2 Definitions of Electrical Characteristics[1]

Table 3 DC Characteristics at T_A = 25 °C, unless otherwise specified

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Reverse working voltage	V_{RWM}	–	–	5.5	V	I/O to *GND*
Reverse current	I_R	–	<1	100	nA	V_R = 5.5 V, I/O to *GND*

Table 4 RF Characteristics at T_A = 25 °C, unless otherwise specified

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Line capacitance	C_L	–	0.45	1	pF	V_R = 0 V, f = 1 MHz, I/O to GND
		–	0.23	0.5	pF	V_R = 0 V, f = 1 MHz, I/O to I/O
Line capacitance	C_L	–	0.25	–	pF	V_R = 0 V, f = 825 MHz, I/O to GND
		–	0.13	–	pF	V_R = 0 V, f = 825 MHz, I/O to I/O
Capacitance variation between I/O and GND	$\Delta C_{i/o\text{-}GND}$	–	0.02	–	pF	V_R = 0 V, f = 1 MHz, I/O to GND
Capacitance variation between I/O	$\Delta C_{i/o\text{-}i/o}$	–	0.01	–	pF	V_R = 0 V, f = 1 MHz, I/O to I/O

Table 5 ESD Characteristics at T_A = 25 °C, unless otherwise specified

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Reverse clamping voltage[1]	V_{CL}	–	9	–	V	I_{PP} = 1 A, t_p = 8/20 µs, I/O pin to GND
		–	12	–	V	I_{PP} = 3 A, t_p = 8/20 µs, I/O pin to GND
Reverse clamping voltage[2][2]	V_{CL}	–	8.9	–	V	I_{PP} = 16 A, t_p = 100 ns, I/O pin to GND
		–	11.5	–	V	I_{PP} = 30 A, t_p = 100 ns, I/O pin to GND
Forward clamping voltage[1]	V_{FC}	–	1.75	–	V	I_{PP} = 1 A, t_p = 8/20 µs, GND pin to I/O
		–	2.5	–	V	I_{PP} = 3 A,t_p = 8/20 µs, GND pin to I/O
Forward clamping voltage[2][2]	V_{FC}	–	5.4	–	V	I_{PP} = 16 A, t_p = 100 ns, GND pin to I/O
		–	9.2	–	V	I_{PP} = 30 A, t_p = 100 ns, GND pin to I/O
Dynamic resistance I/O to GND[2][2]	$R_{DYN, I/O to GND}$	–	0.2	–	Ω	
Dynamic resistance GND to I/O[2][2]	$R_{DYN, GND to I/O}$	–	0.3	–	Ω	

1) I_{PP} according to IEC61000-4-5

2) Please refer to Application Note AN210[2]. TLP parameter: Z_0 = 50 Ω , t_p = 100ns, t_r = 300ps, averaging window: t_1 = 30 ns to t_2 = 60 ns, extraction of dynamic resistance using least squares fit of TLP charactertistic between I_{PP1} = 10 A and I_{PP2} = 40 A.

3.2 Typical Characteristics at T_A = 25 °C, unless otherwise specified

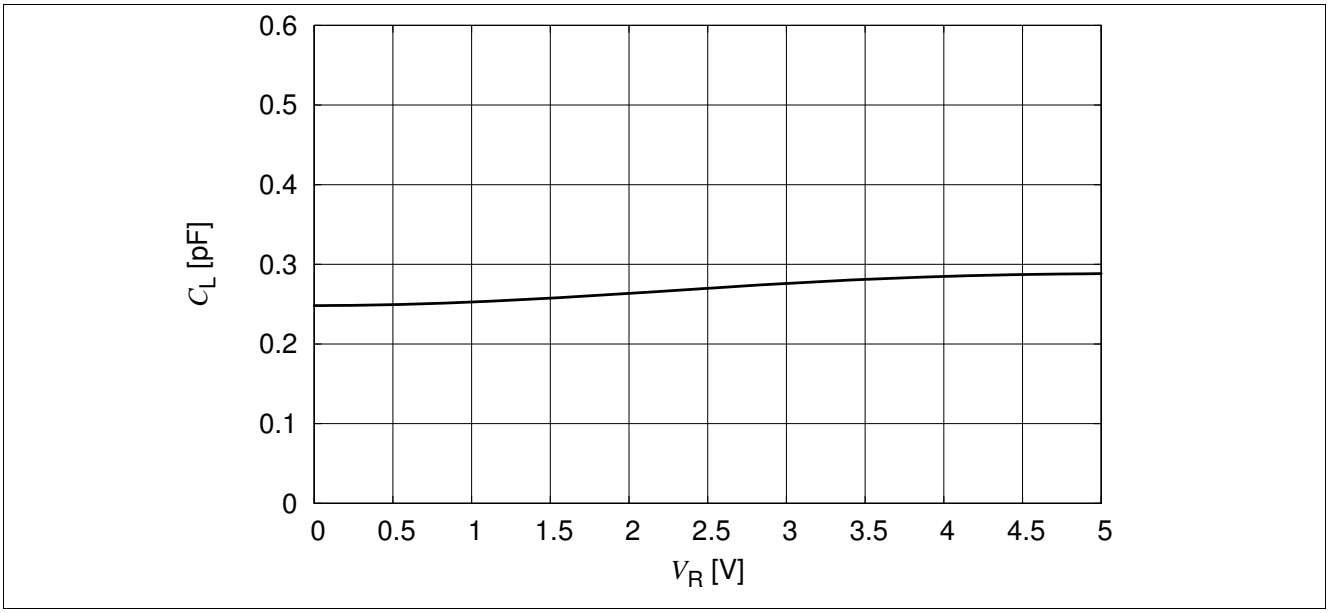

Figure 3 Line capacitance $C_L = f(V_R)$ at f = 825 MHz

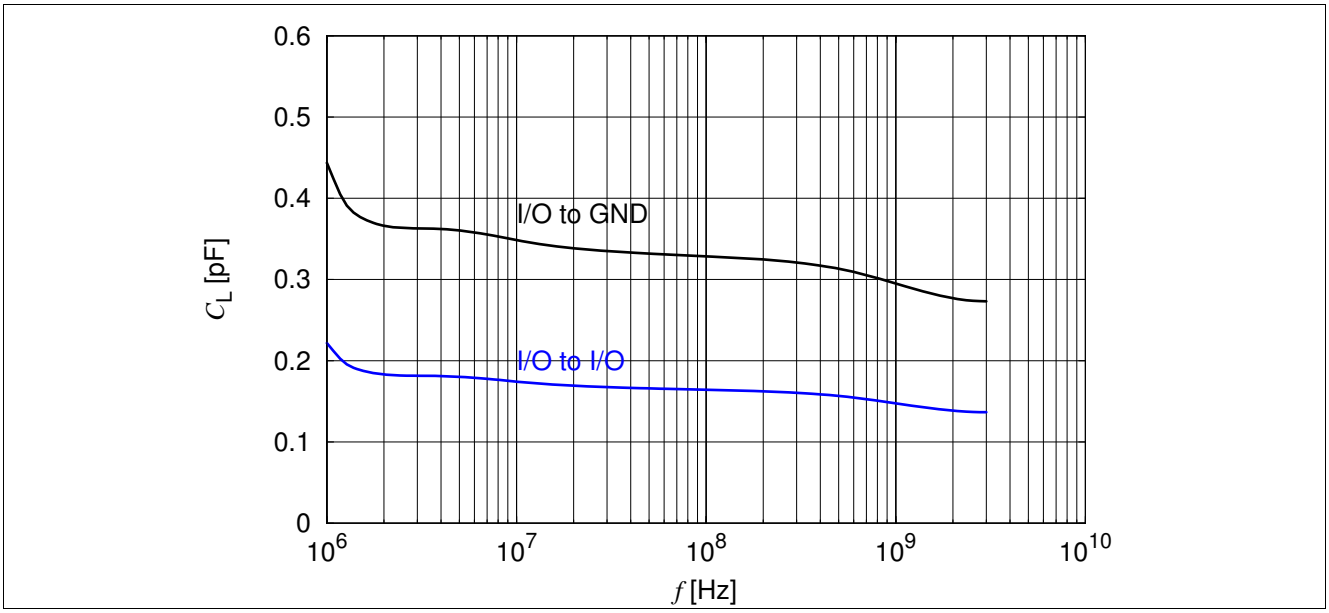

Figure 4 Line capacitance $C_L = f(f)$, V_R = 0 V

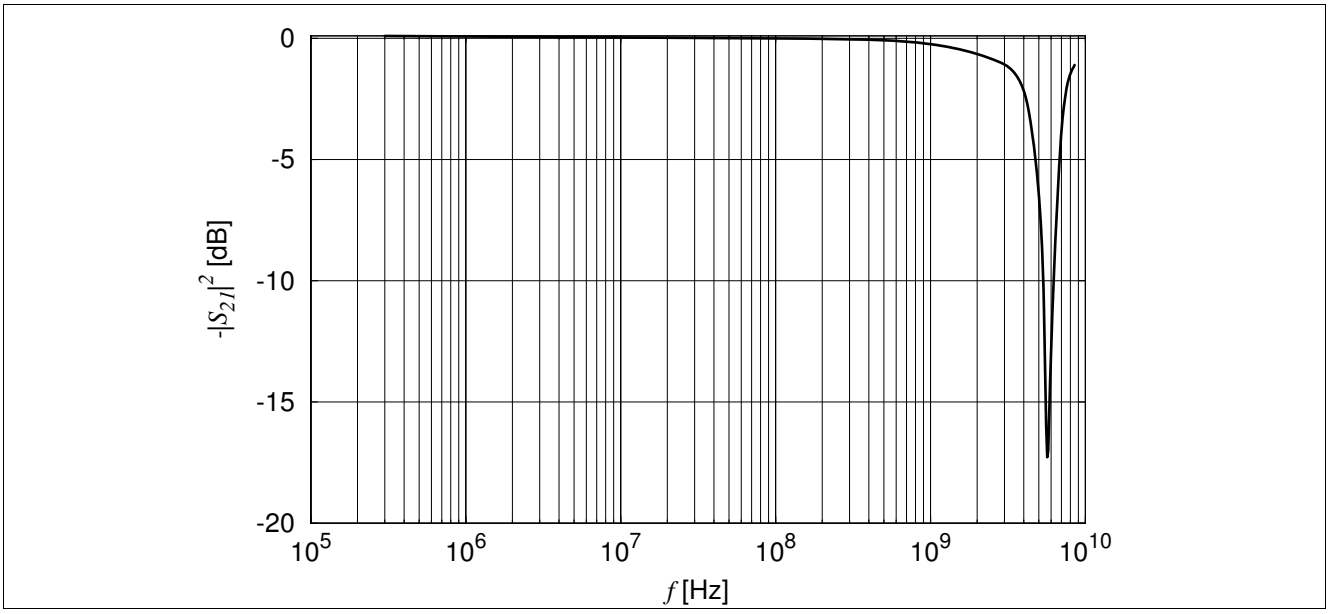

Figure 5 Insertion loss $I_L = f(f)$, $V_R = 0$ V

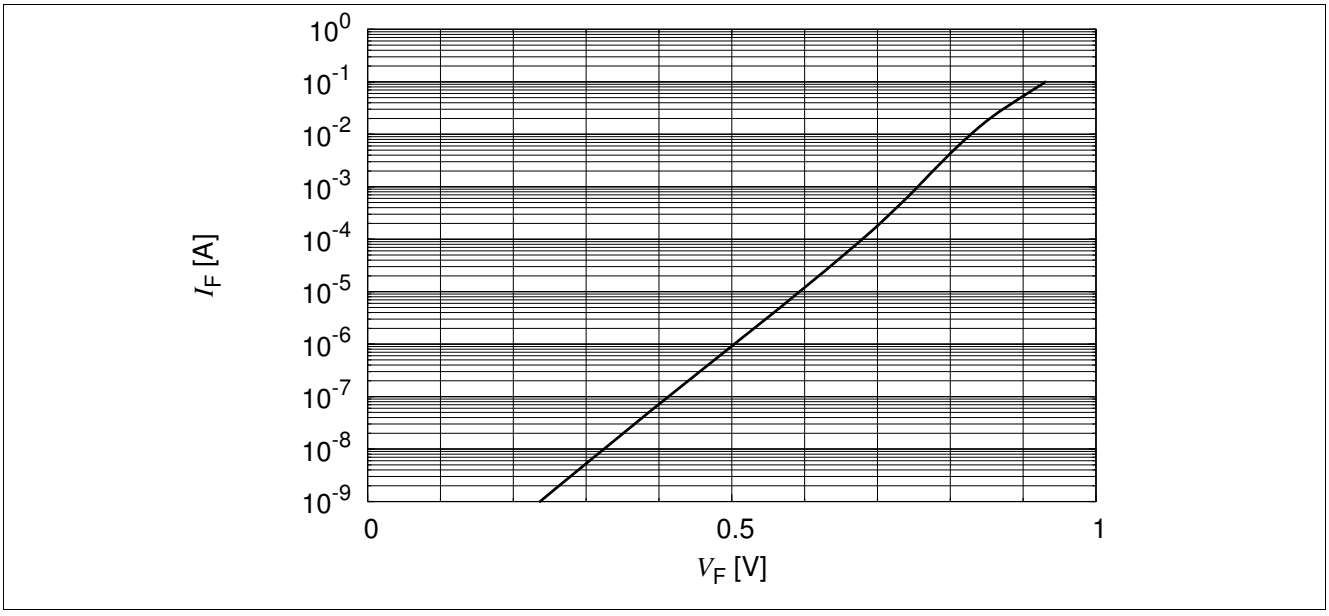

Figure 6 Forward characteristic, $I_F = f(V_F)$, current forced

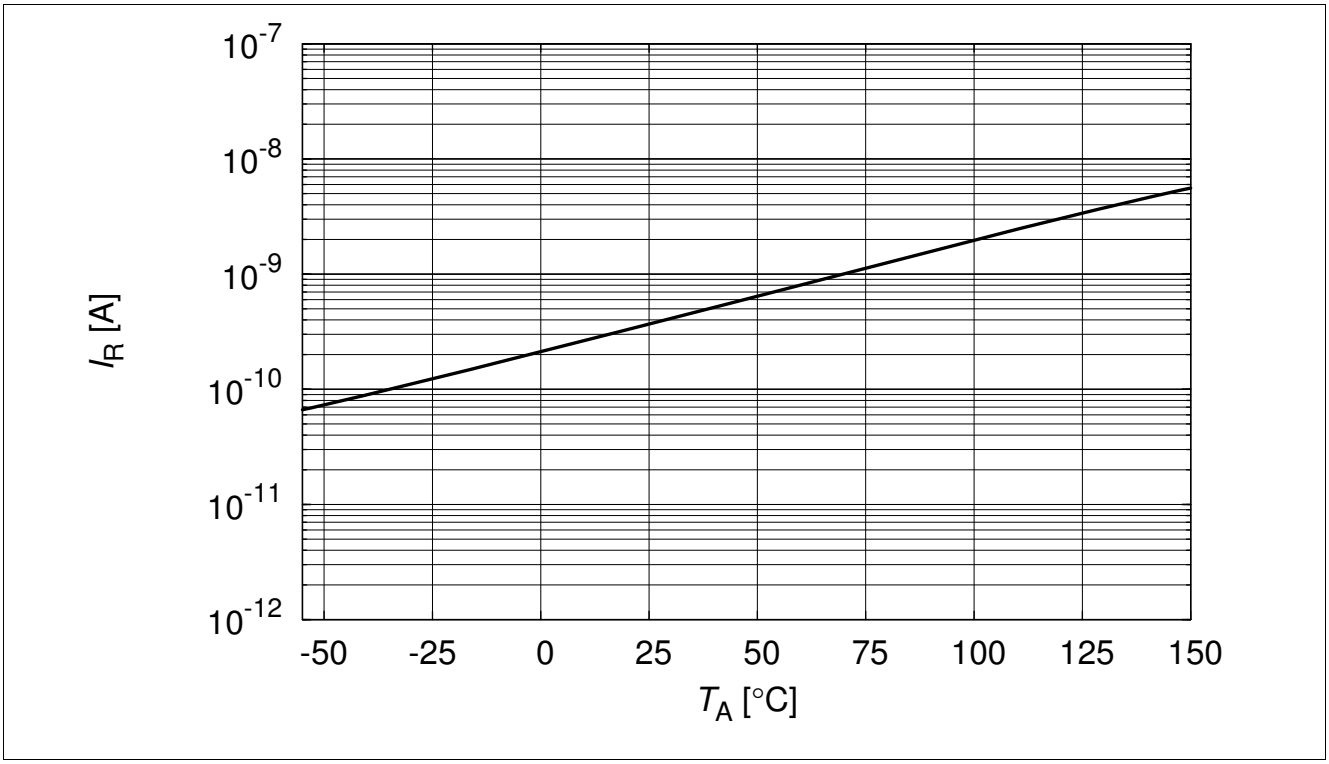

Figure 7 Reverse current $I_R = f(T_A)$, V_R = 5.5 V (typical)

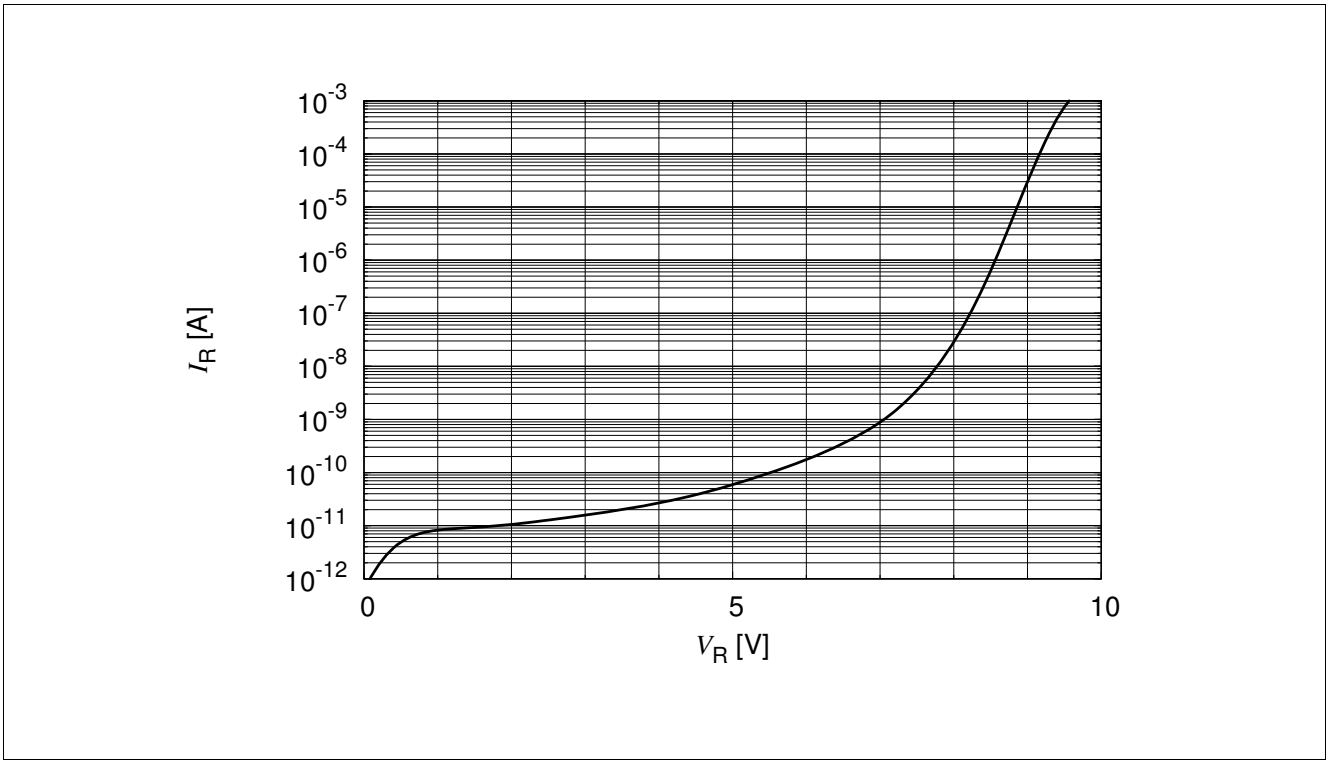

Figure 8 Reverse characteristic, $I_R = (V_R)$, voltage forced

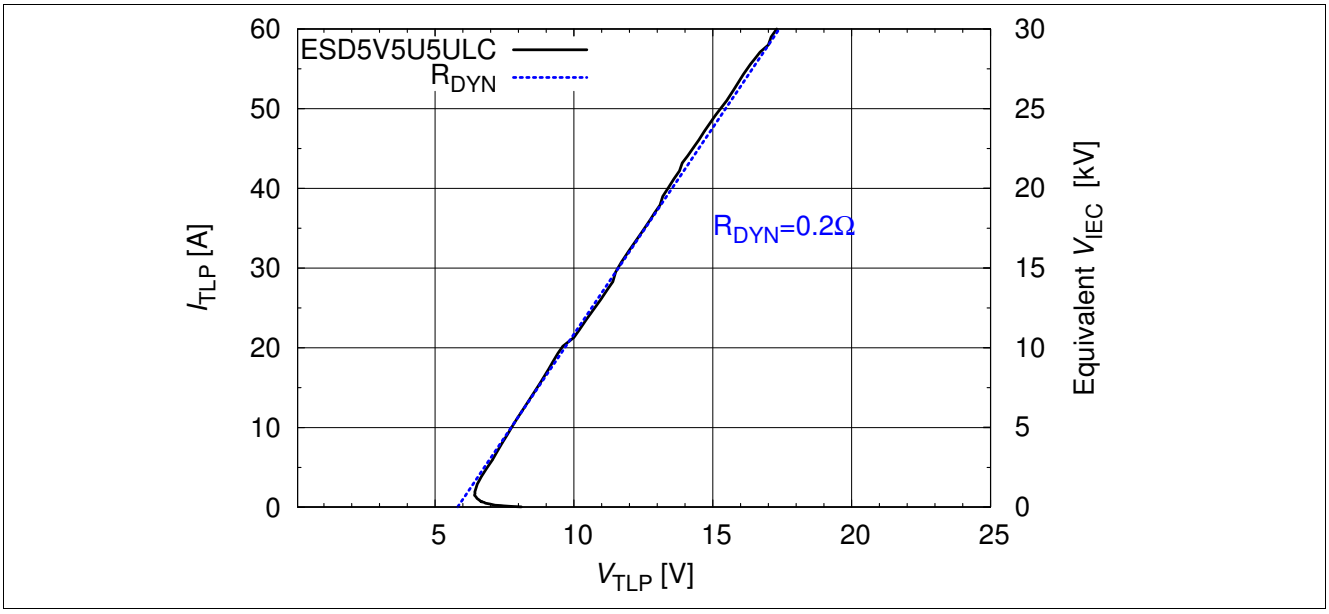

Figure 9 TLP characteristic I/O to GND Note: [2]

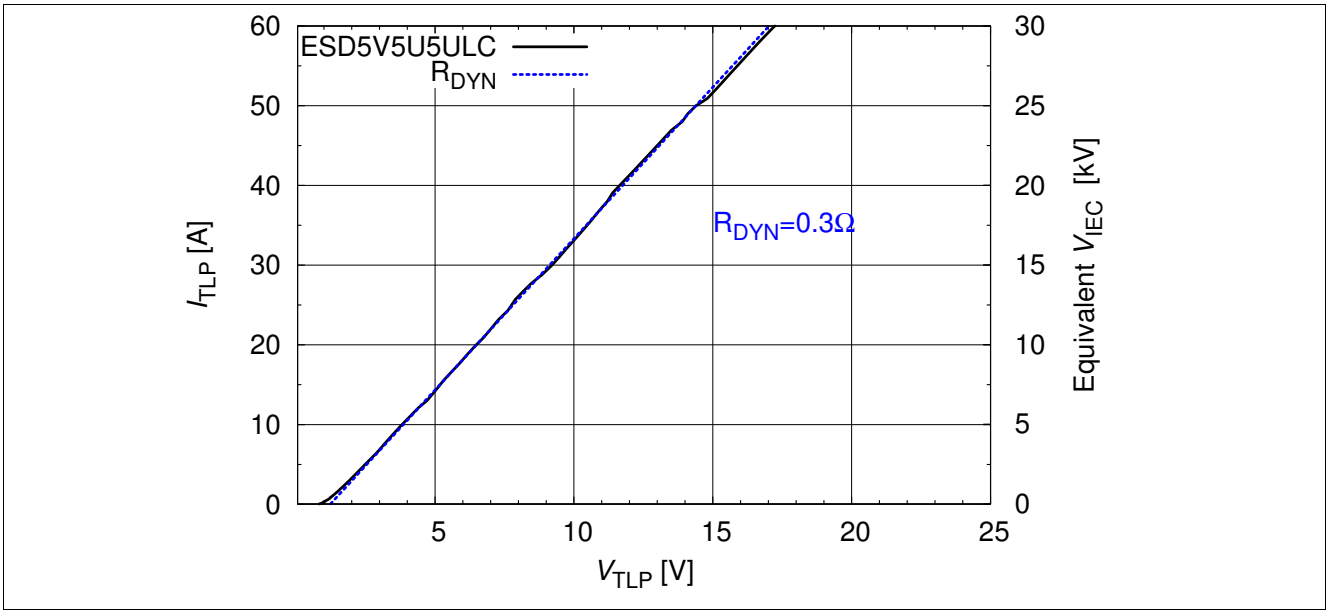

Figure 10 TLP characteristic GND to I/O Note: [2]

Note: TLP parameter: Z_0 = 50 Ω, t_p = 100 ns, t_r = 300 ps, averaging window: t_1 = 30 ns to t_2 = 60 ns, extraction of dynamic resistance using least squares fit of TLP charactertistic between I_{PP1} = 10 A and I_{PP2} = 40 A. The equivalent stress level V_{IEC} according IEC 61000-4-2 (R = 330 Ω, C = 150 pF) is calculated at the broad peak of the IEC waveform at t = 30 ns with 2 A / kV

4 Application Information

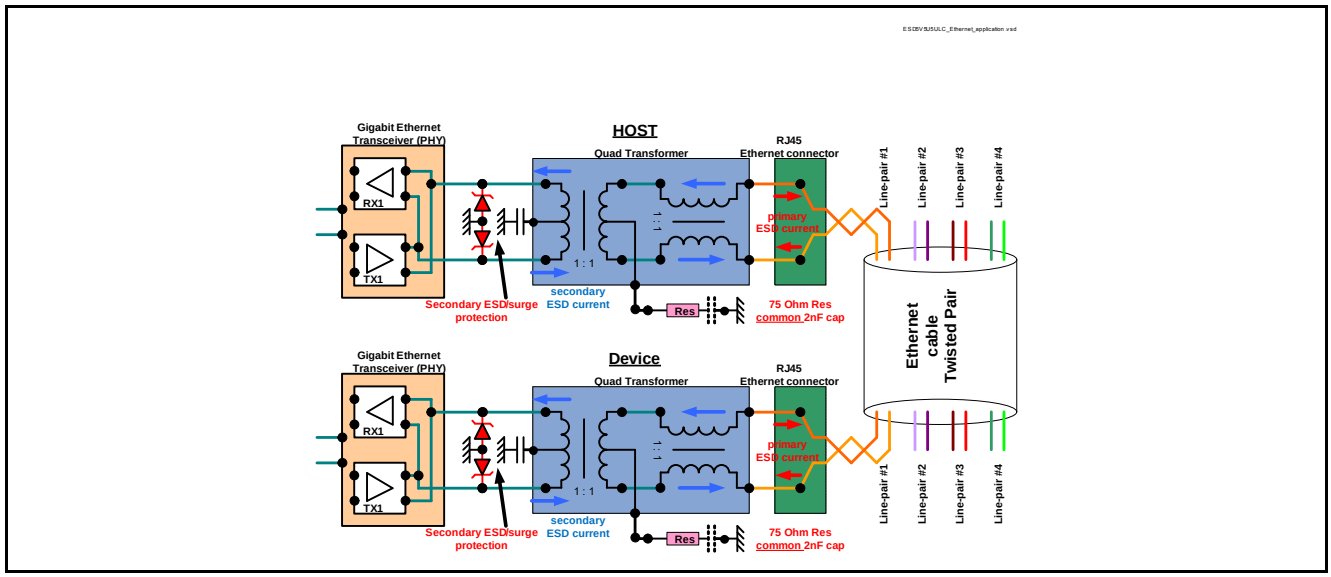

Figure 11 Ethernet

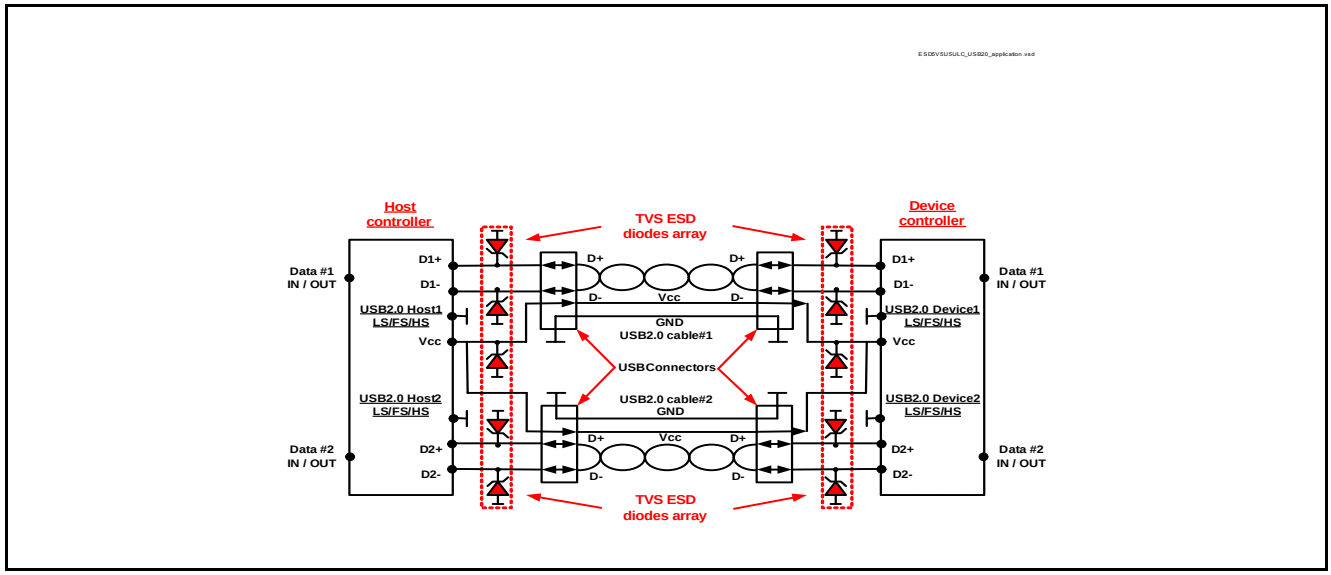

Figure 12 USB2.0

5 Ordering Information Scheme (Examples)

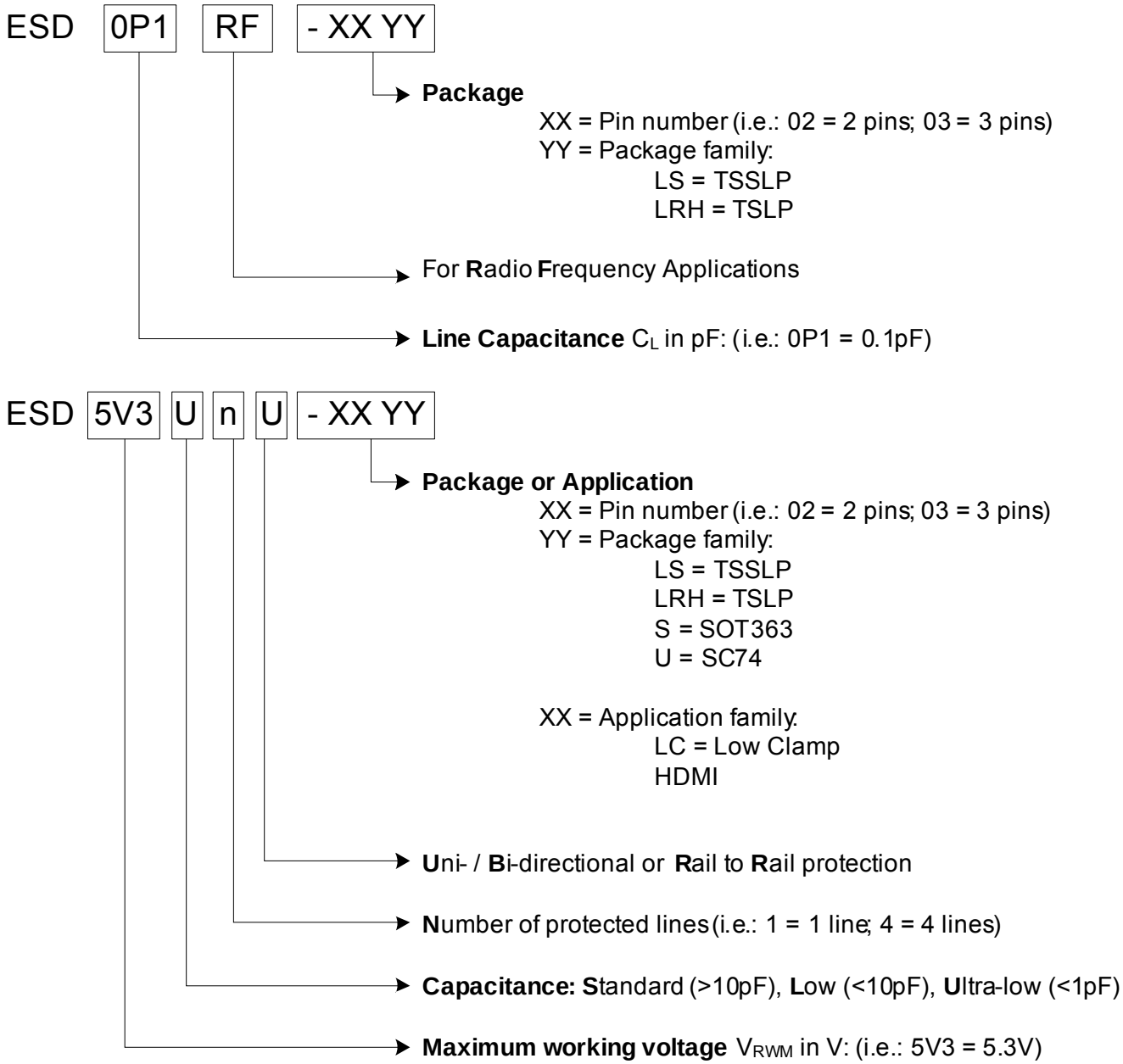

Figure 13 Ordering information scheme

6 Package Information

6.1 PG-SC74 (mm)

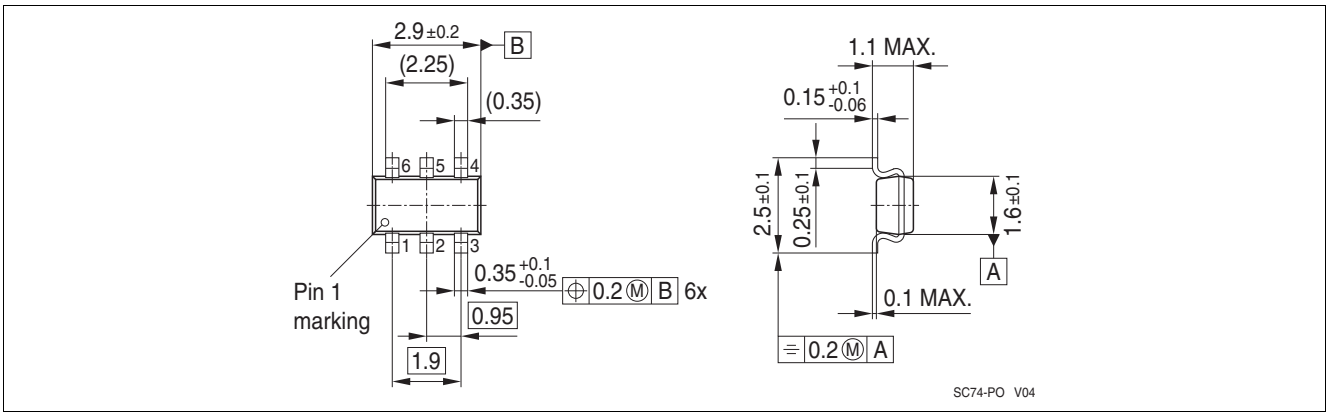

Figure 14 PG-SC74: Package overview

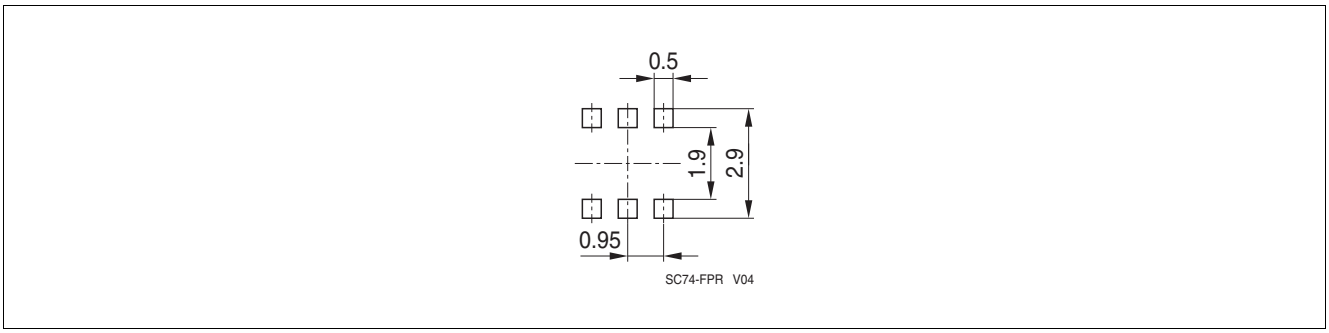

Figure 15 PG-SC74: Footprint

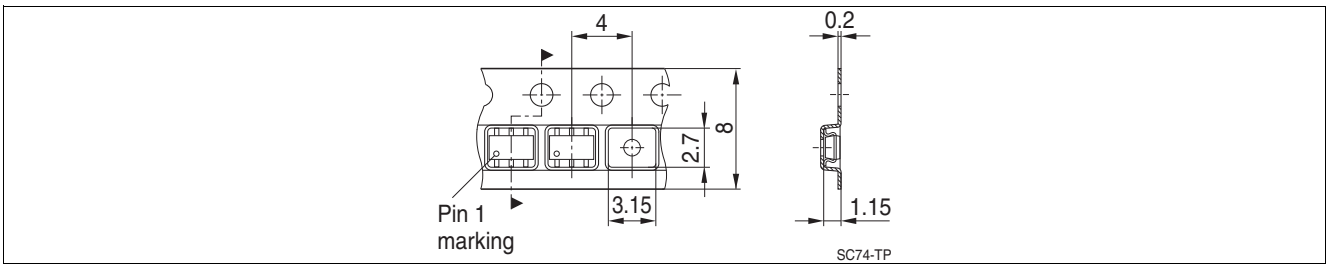

Figure 16 PG-SC74: Packing

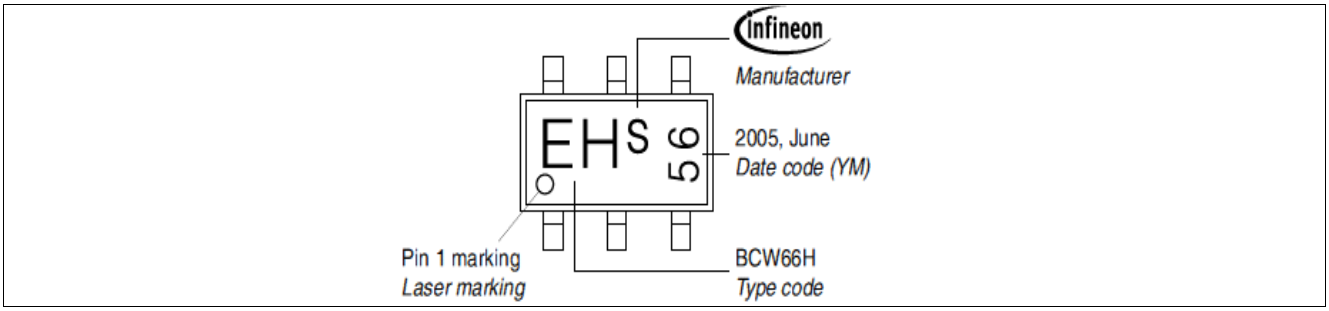

Figure 17 PG-SC74: Marking (example)

References

[1] **On-chip ESD protection for integrated circuits**, Albert Z. H. Wang, ISBN:0-7923-7647-1

[2] Infineon Technologie AG - **Application Note AN210**: Effective ESD Protection Design at System Level Using VF-TLP Characterization Methodology

Terminology

C_L	Line capacitance
DSC	Digital Still Camera
DVD	Digital Versatile Disc
DVI	Digital Visual Interface
EFT	Electrical Fast Transient
ESD	Electrostatic Discharge
HDMI	High Definition Multimedia Interface
IEC	International Electrotechnical Commission
I_{PP}	Peak pulse current
I_R	Reverse current
I_{RWM}	Reverse working current maximum
LCD	Liquid Crystal Display
MP3	Moving Picture Experts Group III
PCB	Printed Circuit Board
R_{DYN}	Dynamic resistance
RoHS	Restriction of Hazardous Substances Directive
S-ATA	Serial Advanced Technology Attachment
STB	Set-Top-Box
T_A	Ambient temperature
TLP	Transmission Line Pulse
T_{OP}	Operation temperature
t_p	Pulse duration
t_r	Pulse rise time
T_{stg}	Storage temperature
USB	Universal Serial Bus
V_{CL}	Reverse clamping voltage
V_{ESD}	Electrostatic discharge voltage
V_{FC}	Forward Clamping Voltage
V_{Hold}	Holding Voltage
V_{IEC}	Equivalent stress level according IEC61000-4-2 (R = 330 Ω , C = 150 pF)
V_R	Reverse voltage
V_{RWM}	Reverse working voltage maximum
V_{Trig}	Triggering Voltage
Z_0	Impedance

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